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ABSTRACT

An analysis of the geographic distribution of native languages in Canada's provinces gives an overview of the distribution of three native speaker groups: English, French, and all other languages combined. The study gives particular emphasis to changes or trends appearing between 1971 and 1981, with 1971 data used as a baseline. A language segregation index of 0 (no segregation) to 1.00 (maximum segregation) is used to indicate the relative proportion of native speakers of each group. Distributions of native speakers from each language group and of native speakers of the province's official languages are also indicated for each province by percentages of native speakers, mutual information values, and comparisons of observed and expected proportions for 1971 and 1981. Overall, the changes found were minor, with the English and French groups maintaining their high degree of segregation. While some of the distribution changes are explained by statistical measures, the processes underlying the changes are unexplained and require further analysis of trends in bilingualism, minority language maintenance and shift, and migration. (MSE)

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THE SPATIAL ORGANIZATION OF LANGUAGE IN CANADA, 1981

John de Vries

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IN GEOLINGUISTICS
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The Spatial Organization of Language in Canada, 1981

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The Spatial Organization of Language in Canada, 1981*

1. Introduction

Earlier work on Canada's language situation has demonstrated the existence of rather durable spatial patterns. Such analyses, traditionally based on Census data, show the persistence of concentration by mother tongue, ethnic origin or the ability to speak English or French from the beginning of the 20th century through 1971 or 1976 (details may be found in Joy, 1972; Lachapelle and Henripin, 1982; Lieberson, 1970; Maheu, 1970; Vallee and de Vries, 1978; de Vries and Vallee, 1980).

This analysis updates that work through 1981, on the basis of the 1981 Census. In particular, changes which occurred in the decade 1971-1981 will be analyzed in somewhat more detail. In this paper, provinces are used as units of analysis.

2. The Distribution of Mother Tongue Categories

For the sake of simplicity, I have divided the responses to the question on mother tongue into three categories: English, French and Other. The last category, thus, includes all of the "non-official" languages, those of Native Canadians as well as those associated with

*Much of this paper was written during my tenure as Visiting Researcher in the Social and Economic Studies Division of Statistics Canada. I would like to ackowledge, in particular, the comments made by Rejean Lachapelle and Brian Harrison. Responsibility for this version is, of course, mine only.

immigrants. At this stage, these "other" languages are given least emphasis. Eventually, more detailed work will have to be done on the largest language groups included in the category "other".

In 1981, a little over 61 percent of the population had English as mother tongue, about 26 percent French, while the remaining 13 percent had a mother tongue other than French or English.

Overall this shows very little change from 1971, when corresponding percentages were 60, 27 and 13. The intercensal decade showed a slight increase in the proportion with English as mother tongue, a slight decrease in the French category, while the "other" mother tongue category maintained roughly the same proportion in the Canadian population. Such marginal processes of change are extremely slow, as they have been for the entire period for which comparable data are available. Not surprisingly, then, much of what will be written about the 1981 language patterns will be a virtual repetition of what has been written about the 1971 patterns. In what follows, the 1971 information will be used as a baseline from which the more recent data may be evaluated and analyzed.

When we consider the spatial segregation between the three other tongue categories we find, again, that little has changed between 1971 and 1981. See Table 1.

TABLE 1
Segregation Indexes Between Mother Tongue Categories,
Canada, 1971 and 1981

	English	French	Other
English	-	.810	.137
French	.785	-	.750
Other	.158	.744	-

Notes: Segregation indexes are based on the distribution of the population by province.
Upper triangle gives values for 1981, lower triangle for 1971.

The segregation index, used in the table (also known as the index of dissimilarity, or "delta") has a range from 0 (no segregation) to 1.00 (maximal segregation). Values may be interpreted as "the proportion of one group which would have to be redistributed for the two percentage distributions to be identical". To illustrate: the segregation between English and French mother tongue groups in 1981 had an index value of .81. In other words, 81 percent of either group would have to move to another province for the percentage distributions of the English and French mother tongue groups by province to be identical. See de Vries and Vallee, 1980:74 for further details. A detailed discussion of segregation indices is provided in James and Taeuber, 1982.

The decade 1971-81 showed, again, very little change: the French and English mother tongue categories were already highly segregated in 1971 and became even more so by 1981. The segregation between French and "other" mother tongues, also high in 1971, increased by a tiny amount, while the segregation between English and "other" decreased somewhat. Even at the

relatively crude level of provinces, the data show the slightly increased tendency towards the "two solitudes", with the French mother tongue population increasingly concentrated in Quebec and New Brunswick (these two provinces contained 87.7% of the French mother tongue population in 1971, 88.8% in 1981) and the English mother tongue population increasingly concentrated in the rest of the country (Quebec and New Brunswick together contained 9.2 percent of the English mother tongue population in 1971, but only 7.8 percent in 1981.) Despite these observable changes, we again notice the slow rate of change in these patterns. As we shall see, the percentage distribution of mother tongue by province for 1971 gives a good description of the patterns for 1981. Tables 2 and 3 give these distributions for 1971 and 1981 respectively. We see the slight decline in the share having French as mother tongue, a small increase in the proportion with English as mother tongue, and virtually no change in the segment with an "other" mother tongue.

TABLE 2
Percentage Distribution of Mother Tongue,
by Province, Canada, 1971

	English	French	Other	Total
Newfoundland	3.97	0.06	0.14	2.42
Prince Edward Island	0.79	0.13	0.04	0.52
Nova Scotia	5.65	0.68	0.57	3.66
New Brunswick	3.16	3.72	0.30	2.94
Quebec	6.08	84.01	13.26	27.95
Ontario	46.03	8.32	44.61	35.72
Manitoba	5.11	1.04	9.46	4.58
Saskatchewan	5.29	0.55	7.45	4.29
Alberta	9.74	0.80	11.33	7.55
British Columbia	13.93	0.66	12.12	10.13
Yukon	0.12	0.01	0.09	0.08
Northwest Territories	0.13	0.02	0.62	0.16
Total	100.00	100.00	99.99	100.00
Percent of Total	60.15	26.86	12.99	100.00

TABLE 3
Percentage Distribution of Mother Tongue,
by Province, Canada, 1981

	English	French	Other	Total
Newfoundland	3.78	0.04	0.13	2.34
Prince Edward Island	0.77	0.10	0.04	0.50
Nova Scotia	5.33	0.58	0.57	3.49
New Brunswick	3.04	3.75	0.27	2.86
Quebec	4.71	84.98	13.49	26.45
Ontario	44.74	7.58	46.49	35.44
Manitoba	4.93	0.84	7.43	4.21
Saskatchewan	5.17	0.41	5.35	3.97
Alberta	12.17	0.99	11.34	9.19
British Columbia	15.06	0.71	14.20	11.27
Yukon	0.14	0.01	0.08	0.10
Northwest Territories	0.17	0.02	0.62	0.19
Total	100.01	100.01	100.01	100.01
Percent of Total	61.25	25.64	13.11	100.00

While the marginal frequencies did not show much change between 1971 and 1981, the distributions by province did show, in a number of places, somewhat larger differences. We note, in particular, the increasing proportions of the English mother tongue population in Alberta and British Columbia, compared with decreased in Quebec and all of the Atlantic provinces. For the population of French mother tongue, we note especially the increased concentration in the province of Quebec. For the third segment, that of "other" mother tongues, we see slight increases of the shares in Ontario and British Columbia.

A difficulty with the values in tables 2 and 3 is that they add up to 100 percent in every column; as such, columns pertaining to a particular mother

tongue segment may be compared. It is, however, not the case that populations have remained stationary during this intercensal decade. The total Canadian population increased, as a result of births exceeding deaths and immigration exceeding emigration. To obtain a more detailed view of the change, I calculated the percentage change, for each cell in tables 2 and 3, based on the measured group size. The results are given in table 4.

TABLE 4
Percentage Change for the Period 1971-81,
by Mother Tongue and Province, Canada

	English	French	Other	Total
Newfoundland	8.08	-26.10	4.57	7.98
Prince Edward Island	10.25	-19.70	11.02	8.58
Nova Scotia	7.15	-9.25	12.57	6.44
New Brunswick	9.38	7.52	1.36	8.64
Quebec	-11.95	7.83	14.64	5.66
Ontario	10.51	-2.94	17.45	10.79
Manitoba	9.72	-14.13	-11.49	2.58
Saskatchewan	11.11	-19.87	-19.05	3.26
Alberta	42.01	30.97	12.73	35.98
British Columbia	22.94	14.88	32.07	24.21
Yukon	31.41	15.56	-8.27	25.49
Northwest Territories	51.13	6.01	13.35	30.82
Total	11.91	6.60	12.71	11.77

The bottom line shows that the total Canadian population increased by 11.77 percent between 1971 and 1981. This overall increase did not, however, apply equally to the three mother tongue segments separately: rates of increase range from 6.6 percent for the population of french mother tongue to 12.7 percent for those of other mother tongues.

These intercensal changes are the results of several demographic processes:

(i) natural increase, i.e. the difference between births and deaths;

(ii) net international migration, i.e. the difference between immigration and emigration;

(iii) net language shifts, in this case manifested by a change in the classification of persons by mother tongue (e.g. someone who in 1971 was classified as having an "other" mother tongue and in 1981 as English would have manifested mother tongue shift).

We know that overall natural increase in Canada, during the period 1971-81, amounted to about 8.3 per thousand (cf. de Vries, 1982:22). While we do not know anything about the magnitude of the other processes, we could entertain some simple hypotheses. We might assume that the overall change for the population of French mother tongue is almost entirely due to natural increase. Thus, we would have to deduce that, for this group, net migration and mother tongue shift would be close to zero. By a similar argument--if we assume that rates of natural increase for the two remaining segments were contributing around 8 percent to their intercensal increase--we may postulate that their growth was also attributable to net migration and net mother tongue shift. It is likely that net international migration was the more important factor for those of other mother tongues; for those of English mother tongue, language shift may also have contributed.

When we look at the detailed figures in Table 4, we see that the overall growth rate of 11.9 percent for the English mother tongue category masks rather large variations by province. Quite high rates of increase are,

again, registered by Alberta, British Columbia, the Yukon and the Northwest Territories. If it is indeed the case that these provinces and territories gained substantially through net migration, it appears that migrants were predominantly of English mother tongue. In all these cases, except British Columbia, growth rates for the English mother tongue segment exceeded total provincial growth rates. It should be noted that such a net differential could have been caused by a combination of several processes: higher probabilities of immigration for persons of English mother tongue, and higher probabilities of out-migration for others ("out-migration" may not be easily distinguished from mother tongue shift).

At the other end of the range, we find that the English mother tongue segment in Quebec decreased by about 12 percent. Such a decrease could be the result of a negative migration balance, or of net shift to French mother tongue or both. The remaining provinces had intercensal growth rates at or above those we might expect on the basis of natural increase. This suggests that, for example, Manitoba or Saskatchewan (both of which had very low total intercensal growth rates) may well have had net migration losses for all mother tongue categories, combined with net language shift towards English mother tongue from persons of French or other mother tongue.

Such influences are further supported by the growth rates for the provincial French mother tongue populations. The overall growth rate of 6.6 percent is exceeded in Alberta, British Columbia, the Yukon, Quebec and New

Brunswick. Virtually all of the other values are negative, indicating a decline in the size of these groups. For the first three provinces, the high growth rates are probably the result of net migration (one would be best not to put much weight on the rate of increase for the Yukon, where frequencies were quite small). Since growth rates are smaller than the corresponding provincial total rates, it may be that persons of French mother tongue were underrepresented in the migration flows into these provinces, or overrepresented in the flows from them. Alternatively, it may be that a positive net migration balance was partly offset by losses through mother shift. In Quebec and New Brunswick, the French mother tongue groups may have had positive net migration balances. In addition, mother tongue shift to French may have been zero or small positive in Quebec; it was probably negative but small for New Brunswick. For the remaining provinces, the declines in the size of the French mother tongue population may have been the result of negative migration balances, or the effect of mother tongue shift towards English, or both.

The "other" mother tongue category had considerably less variation across provinces than did those of English and French mother tongue. Above average rates for British Columbia (of 32 percent) contrasted with decreased in size for Manitoba, Saskatchewan and the Yukon,. Net shift towards English may well have been a significant factor in these last three cases. The relatively high rates of increase for Quebec and Ontario probably reflect international migration, which has traditionally favoured these two central provinces.

The detailed analysis of growth rates by mother tongue and provinces revealed some changes which were hidden by the high degree of stability in the marginal distributions. The excursus into the provincial growth rates suggests that we should pay particular attention to the English mother tongue group in Quebec and to the French mother tongue groups in all provinces except Quebec and New Brunswick. Particularly interesting may be the changes in Manitoba and Saskatchewan, which were not all that obvious when we dealt with the marginal changes by mother tongue.

Readers who have followed the demographic, political and social developments in Canada since the early seventies are likely to say, at this point, that we have spent considerable energy in "revealing" something which was already known. We "know" that the English population of Quebec has declined; we also "are aware" of the vulnerable position of the French minorities outside Quebec and New Brunswick. The rather methodical development of the analysis so far has two functions: first of all, a pedagogical one. I have tried to demonstrate that somewhat subtle changes may be masked by overall marginal stability. If we were considering comparable data for another society, say Finland or Switzerland, we might not a priori "know" about such regional shifts. A naive analyst might be tempted to stop if marginal distributions showed very little change, and would thus miss the lower-level changes.

The second purpose was methodological as well as pedagogical: the gradual "unfolding" of the analysis has produced a nice fit between what we "know"

from the mass media (or other sources) and the census data. This should give us some faith in the descriptive potential of the census data.

It may be educative to consider the intercensal change in even further detail. One way to do this is by means of a method of analysis developed by Theil (1972), generally called statistical decomposition analysis. To show the association between a person's province of residence and mother tongue, I calculated values of mutual information (Theil, 1972:125). That is, when we have a distribution p_{ij} (where i = province, j = mother tongue and p_{ij} is the proportion of the total population in province i with mother tongue j) and marginal distributions $p_{i.}$ and $p_{.j}$ (for province and mother tongue, respectively), the mutual information is given as $\ln\left[\frac{p_{ij}}{p_{i.}p_{.j}}\right]$. Obviously, when there is statistical independence between the two characteristics, we will find that $p_{ij} = p_{i.}p_{.j}$ for all i,j and that thus the mutual information will be 0. If the two characteristics are not independent, not all values for p_{ij} will be 0. Positive values indicate overrepresentation (that is, more persons in cell $\{i,j\}$ than one would expect under conditions of statistical independence). Similarly, negative values indicate underrepresentation. The magnitude of the mutual information for a given cell $\{i,j\}$ is associated with the degree of overrepresentation or underrepresentation.

The data for 1971 and 1981 are given in Tables 5 and 6.

TABLE 5
Mutual Information for the Cross-Classification of
Province of Residence by Mother Tongue, Canada, 1971

	English	French	Other
Newfoundland	.494	-3.644	-2.860
Prince Edward Island	.430	-1.407	-2.597
Nova Scotia	.435	-1.686	-1.846
New Brunswick	.073	.235	-2.284
Quebec	-1.525	1.101	-.746
Ontario	.254	-1.457	.222
Manitoba	.109	-1.477	.725
Saskatchewan	.208	-2.060	.551
Alberta	.255	-2.239	.407
British Columbia	.319	-2.738	.179
Yukon	.328	-2.435	.084
Northwest Territories	-.242	-2.158	1.342

TABLE 6
Mutual Information for the Cross-Classification of
Province of Residence by Mother Tongue, Canada, 1981

	English	French	Other
Newfoundland	.478	-4.00	-2.893
Prince Edward Island	.429	-1.641	-2.579
Nova Scotia	.424	-1.799	-1.807
New Brunswick	.061	.271	-2.344
Quebec	-1.725	1.167	-.673
Ontario	.233	-1.542	.271
Manitoba	.158	-1.609	.568
Saskatchewan	.263	-2.272	.299
Alberta	.281	-2.232	.210
British Columbia	.290	-2.770	.231
Yukon	.357	-2.510	-.230
Northwest Territories	-.127	-2.271	1.197

We see that the overall association between province of residence and mother tongue did not change all that much. (We would not have expected this either, given the preceding analyses.) The median value (across provinces) for English mother tongue changed from .254 in 1971 to .272 in 1981; corresponding values were from -1.873 to -2.015 for French mother tongue and from .131 to -.010 for Other mother tongue. The data for English mother tongue show the well-known negative association with Quebec residence, which became somewhat stronger between 1971 and 1981. The westward movement of the population of English mother tongue between 1971 and 1981 can be seen clearly in these data: values increased for Manitoba, Saskatchewan and Alberta, and decreased for Ontario and all of the provinces to the east. Finally, these values on mutual information for the English mother tongue demonstrate the persistent "ecology of language" in Canada; the further one moves either East or West from Quebec, the stronger the association between province and English mother tongue (the exception is Ontario, where the degree of overrepresentation is not as large as we would expect, given the values for Quebec and Manitoba).

Similar patterns, though of opposite signs, are shown by the values of French mother tongue. They show a maximum for Quebec and relatively steady declines as one moves West or East. Whereas the values for the English mother tongue segment suggested a westward drift between 1971 and 1981, those for French mother tongue indicate increased concentration in Quebec and New Brunswick. Only Alberta was an exception to this overall pattern. As I suggested earlier, Alberta appears to have had a positive migration balance for the population of French mother tongue.

Following the statistical decomposition methodology, I then analyzed to what degree the observed changes in the marginal distributions (by province and by mother tongue) could explain the changes in the joint distribution. Quite obviously, if we find that the population of Alberta (to take one example) increased rapidly, we might hypothesize that all of the groups in that population have grown rapidly (the null hypothesis would be, in this case, that all three of Alberta's mother tongue categories had the same intercensal growth rate). Such a phenomenon could, by itself, explain the above average rate of increase for the English mother tongue segment in the total Canadian population (given its overrepresentation in Alberta) and the below average growth rate for the French mother tongue population (given its underrepresentation), as long as differential provincial rates of increase were not completely the result of internal migration. By similar arguments we could hypothesize that the above average growth rate for those of English mother tongue could "explain" the high growth rates for Alberta and British Columbia, we well as the low growth for Quebec (again based on the observed associations reflected in Tables 5 and 6). Such simple-minded explanations would not help us at all in explaining the low growth rates for Manitoba and Saskatchewan, however. In any case, it is clearly not true that changes in the joint distribution can be entirely attributed to differential rates of increase for the categories of one marginal distribution only. Obviously, if we observe rather pronounced differences in the growth rates for categories of both of the marginal variables, the resulting joint distribution may well be the product of the initial joint distribution and changes in the two marginal distributions only. (This

line of analysis is analogous to that followed in the study of occupational mobility, where some part -- structural mobility -- is attributable to changes in the marginal distributions, while the remainder --exchange mobility -- indicates additional moves between marginal categories.)

We can calculate the expected joint distribution which would result if intercensal changes were only due to the marginal changes. Table 7 gives these expected values, as well as the observed values for 1971 and 1981. When we compare the expected values with the observed values for 1981, we see that the method of "marginal adjustments" in general provides reasonably good estimates of the values after a decade of change. The overall change can be measured, following, Theil, by a summary measured called information inaccuracy. This measure is calculated as:

$$\sum_{i=1}^{m} \sum_{j=1}^{n} q_{ij} \ln \frac{q_{ij}}{p_{ij}}$$

where p_{ij} represents the joint distribution in 1971 and q_{ij} represents the joint distribution in 1981. A quick inspection of the above formula shows that we are measuring the degree to which the initial distribution (p_{ij}) "predicts" the final distribution (q_{ij}). If there were no changes, for any combination of i and j, all the m x n components of the information inaccuracy would be zero (as would their sum). Under all other conditions, the sum of these m x n components will be larger than zero. Greater deviations from zero indicate greater inaccuracy in "predicting" q_{ij} on the basis of p_{ij}.

The total information inaccuracy yielded a value of .00498. We can now calcualte a similar measure, using the expected distribution as our

TABLE 7

Observed (1971 and 1981) and Expected Proportions, Joint Distribution of Province by Mother Tongue, Canada, 1971-1981

	English			French			Other		
	Observed		Expected	Observed		Expected	Observed		Expected
	1971	1981	1981	1971	1981	1981	1971	1981	1981
Newfoundland	.0239	.0231	.0231	.0002	.0001	.0002	.0002	.0002	.0002
Prince Edward Island	.0048	.0047	.0047	.0003	.0003	.0003	.0000	.0000	.0000
Nova Scotia	.0340	.0326	.0324	.0018	.0015	.0017	.0008	.0008	.0007
New Brunswick	.0190	.0186	.0185	.0100	.0096	.0097	.0004	.0004	.0004
Quebec	.0366	.0289	.0346	.2257	.2179	.2137	.0172	.0177	.0162
Ontario	.2769	.2740	.2749	.0224	.0194	.0222	.0579	.0609	.0572
Manitoba	.0307	.0302	.0283	.0028	.0022	.0026	.0123	.0097	.0122
Saskatchewan	.0318	.0316	.0294	.0015	.0010	.0014	.0097	.0070	.0089
Alberta	.0586	.0745	.0715	.0022	.0025	.0026	.0147	.0149	.0178
British Columbia	.0838	.0922	.0933	.0018	.0018	.0020	.0157	.0186	.0174
Yukon	.0007	.0008	.0008	.0000	.0000	.0000	.0001	.0001	.0001
Northwest Territories	.0008	.0010	.0009	.000	.000	.000	.0008	.0008	.0009

starting point. That is, we are assessing the degree to which the "marginally adjusted" joint proportions predict the observed proportions. This yields a value for the information inaccuracy of .00194. We may view these information inaccuracies as measures of "spread" or "dispersion" (i.e., measures comparable to variances or chi-squares). thus, we can say that the overall information inaccuracy of .00498 has been reduced to .00194 due to the marginal adjustments, or by 61 percent of its initial value.

Careful inspection of the data in Table 7 shows that the estimates are relatively close to the observed 1981 values, except in the following cases:

- English mother tongue in Quebec;
- French mother tongue in Ontario, Manitoba and Saskatchewan;
- Other mother tongue in Manitoba and Saskatchewan.

In all these cases, the data show relatively large declines between 1971 and 1981, of which only a small component is picked up by the estimation technique. For example, the English mother tongue population in Quebec declined from 3.7 percent of Canada's population in 1971 to 2.9 percent in 1981, but the estimate is 3.5 percent. In other words, only one fourth of the actual decline is signalled by the marginal adjustment procedure. The procedure appears to have a tendency to underestimate the magnitude of relatively large changes.

In sum, we may conclude that a large share of the intercensal changes in the mother tongue distribution by province may be attributed to relatively high rates of increase for Alberta, British Columbia and the Northern Territories, and relatively low growth rates for Manitoba, Saskatchewan and Quebec. In addition, there were minor effects due to differential growth rates by mother tongue.

3. The Distribution of Official Language Categories

To shed further light on these intercensal changes in the spatial patterning of language in Canada, I also considered the distribution of the population by "official language(s) spoken": English only, French only, Both and Neither. Tables 8 and 9 give the distribution of official language by province, for 1971 and 1981.

In the marginal distributions, we see a slight decline in the proportion speaking English only, somewhat larger declines in the group which speaks French only and those speaking neither official language, and a fairly strong increase in the proportion able to speak English and French.

Segregation between official language categories, based on the provincial distributions, is summarized in Table 10. We note quite high levels of segregation between those able to speak French only and those who can speak English only, which even increased between 1971 and 1981. Overall, French monolinguals appear to be highly segregated from those unable to speak

TABLE 8
Percentage Distribution of Offical Language
by Province, Canada, 1971

	English Only	French Only	Both	Neither	Total
Newfoundland	3.54	0.01	0.32	0.20	2.42
Prince Edward Island	0.70	0.02	0.31	0.01	0.52
Nova Scotia	5.05	0.11	1.83	0.32	3.66
New Brunswick	2.74	2.60	4.69	0.19	2.94
Quebec	4.37	94.55	57.37	19.86	27.94
Ontario	46.47	2.39	24.69	53.26	35.71
Manitoba	6.09	0.13	2.79	6.45	4.58
Saskatchewan	5.99	0.05	1.59	3.48	4.29
Alberta	10.54	0.09	2,79	5.63	7.55
British Columbia	14.20	0.05	3.50	8.37	10.13
Yukon	0.12	0.00	0.04	0.01	0.09
Northwest Territories	0.18	0.00	0.07	2.22	0.16
Total	99.99	100.00	99.99	100.00	99.99
Percent of Total	67.09	17.99	13.45	1.48	100.01

TABLE 9
Percentage Distribution of Offical Language
by Province, Canada, 1981

	English Only	French Only	Both	Neither	Total
Newfoundland	3.41	0.00	0.35	0.15	2.34
Prince Edward Island	0.69	0.01	0.27	0.01	0.50
Nova Scotia	4.81	0.05	1.69	0.28	3.49
New Brunswick	2.59	2.24	4.96	0.16	2.86
Quebec	2.64	95.97	56.09	17.54	26.45
Ontario	45.90	1.52	25.11	50.85	35.44
Manitoba	5.68	0.07	2.17	5.26	4.21
Saskatchewan	5.61	0.02	1.19	2.47	3.97
Alberta	12.68	0.09	3.87	7.70	9.19
British Columbia	15.62	0.04	4.19	13.40	11.27
Yukon	0.13	0.00	0.05	0.02	0.10
Northwest Territories	0.23	0.00	0.07	2.18	0.19
Total	99.99	100.01	100.01	100.02	100.01
Percent of Total	66.95	16.56	15.29	1.21	100.01

TABLE 10
Segregation Indexes Between Official Language Categories, Canada, 1971 and 1981

	English Only	French Only	Both	Neither
English Only	-	.933	.558	.218
French Only	.902	-	.399	.805
Both	.550	.372	-	.453
Neither	.247	.771	.440	-

Notes: Segregation indexes are based on the distribution of the population by province.
Upper triangle gives values for 1981, lower triangle for 1971.

English or French, while their segregation from those able to speak both of the official languages was at a much lower level. French monolinguals became more segregated from all three other categories during the period 1971-1981. Other values were considerably lower, but they too increased, with the exception of the segregation between English monolinguals and those unable to speak either official language, where a slight decline was noted. Inspection of the Lorenz-curves (not included in this manuscript) reveals that all pairwise comparisons except "English only-Neither" satisfy the Lorenz-criterion. That is, when we superimpose the Lorenz-curve for 1981 on the one for 1971 (for the same pair of official language categories), the two curves do not cross. For the English only-Neither" comparison, the curves cross at two points. We can therefore state unambiguously that segregation increased for all combinations of official language categories, except the "English only-Neither" case, where we are unable to say whether it increased or decreased (see James and Taeuber, 1982:24).

In the preceding section, we noted the increased concentration of the French mother tongue population in Quebec. The data by official language shed further light on this: the proportion of French monolinguals living in Quebec increased from 94.6 percent in 1971 to 96 percent in 1981. A similar concentration was not evident for those able to speak both official languages: the percentage living in Quebec decreased from 57.4 percent in 1971 to 56.1 percent in 1981. The concentration in New Brunswick and Ontario increased somewhat during the same period, so that the percentage of Canada's bilinguals living in these three provinces only declined from 86.9 percent to 86.1 percent. Thus, the increased concentration of the French mother tongue population in Quebec appears to be primarily associated with French monolingualism. Bilingualism - in the "official" variety - appears to have remained a feature of the provinces of New Brunswick, Quebec and Ontario.

The westward drift which we noted for the population of English mother tongue is equally observable for the English monolinguals. The percentage living in the provinces west of Quebec increased from 83.3 in 1971 to 85.5 percent in 1981.

As with the analysis of the patterns by mother tongue, we may consider intercensal growth rates by official language category and province. Consider Table 11. the English monolingual category increased by 11.4 percent, or just a little under the total rate of increase. Recall that the growth rate for the English mother tongue category was 11.9 percent

TABLE 11
Percentage Change for the Period 1971-81, by Categories of Official Language and Province, Canada

	English Only	French Only	Both	Neither	Total
Newfoundland	7.57	-72.55	37.33	-31.20	7.98
Prince Edward Island	9.21	-70.59	7.35	(16.67)	8.58
Nova Scotia	6.03	-55.13	11.56	-21.84	6.44
New Brunswick	5.08	-11.53	34.12	-24.17	8.64
Quebec	-32.61	4.32	24.12	-19.42	5.66
Ontario	10.07	-34.80	29.11	-12.88	10.79
Manitoba	3.86	-47.91	-1.16	-25.48	2.58
Saskatchewan	4.33	-61.48	-5.08	-35.36	3.26
Alberta	34.05	12.10	75.87	24.62	35.98
British Columbia	22.60	-18.59	51.99	46.06	24.21
Yukon	23.76	(-50.00)	50.41	(28.57)	25.49
Northwest Territories	42.67	(-40.00)	29.95	-10.44	30.82
Total	11.43	2.78	26.96	-8.76	11.77

Note: Figures in parentheses are based on 1971 frequencies of less than 100.

(Table 4). Thus, it appears that the English mother tongue population increased its share of the total population through net migration, language shift or differential natural increase, but that some group changed from being monolingual English in 1971 to being bilingual in 1981.

This contrast is much more marked for the French segments: the French mother tongue segment grew by 6.6 percent, but French monolinguals increased only by 2.8 percent (well below what we might expect on the basis of natural increase). It appears that there was considerable movement from French monolingualism to bilingualism. Given the concentration of French monolinguals in Quebec (where they increased at a little less than the provincial growth rate), it is likely that this shift took place largely

outside Quebec. Bilinguals increased by 27 percent, well above the growth rates for the other groups. It is likely that much of this growth may be attributed to second-language acquisition during the intercensal period (rather than higher net migration balances, or lower death rates among bilinguals). Much of this increase may have come from the various official language minorities.

The group speaking neither official language decreased by 8.8 percent. We saw, earlier, that the Other mother tongue category increased by 12 percent during the same period. given that those speaking neither English nor French are almost all from the Other mother tongue category, it is clear that there must have been a considerable rate of acquisition of English, or French, or both, during the period 1971-81.

If we look at the rates of change by province, we will get a clearer picture of what may have happened. Let us take the data column by column. The category speaking English only increased with rates roughly equal to the total provincial growth rates - somewhat higher in Prince Edward Island, Manitoba, Saskatchewan and the Northwest Territories. Markedly lower growth rates were attained for English monolinguals in New Brunswick, while the group registered an absolute decline of about one-third in Quebec. In general, rates of increase for the English monolinguals were lower than those for English mother tongue, compared province by province. Such a pattern might point to several processes: shifts from French mother tongue or Other mother tongue to English mother tongue, and/or from

speaking English only to speaking both English and French. For Quebec, it is safe to hypothesize that the propensity to migrate out of the province, already high for people with English as mother tongue, is substantially higher for those unable to speak French. Note that part of the contrast in rates of decline for the English groups in Quebec may also be due to the acquisition of French by those people who in 1971 resided in Quebec, had English as mother tongue but were then unable to speak French.

For the segment able to speak French only, we see negative growth rates in all provinces except Quebec (with an increase of 4.3 percent) and Alberta (12.1 percent). Declines in the other provinces ranged from 11.5 percent in New Brunswick to over 70 percent for Newfoundland and Prince Edward Island. In these last two provinces, these declines were considerably larger than the corresponding losses to the French mother tongue segment. It appears that we observe the symptoms of relatively rapid language shift, partly intergenerational (shift in mother tongue), partly through the acquisition of English. Such an acquisition of English is indeed hinted at by the high rate of increase in the numbers able to speak both English and French in Newfoundland (over 37 percent). In Prince Edward Island, the process of minority decline may well have progressed to the stage where acquisition of English is partly offset by a decline in the ability to speak French.

Official bilingualism increased in <u>all</u> provinces except Manitoba and Saskatchewan. For the remainder, increases ranged from 7.4 percent in

Prince Edward Island to 76 percent in Alberta. The most likely scenario, then, seems to be that French mother tongue minorities outside Quebec are continuing to lose ground to English. This shift appears to be most advanced in Manitoba and Saskatchewan (where the French mother tongue population decreased in absolute numbers, where the number able to speak French only was cut roughly in half, and where even the ability to speak both English and French declined between 1971 and 1981). Even in New Brunswick - generally considered the province where the French minority was stable - the drift towards English appears to have started: the population of French mother tongue increased by 7.5 percent, but French monolingualism declined by 11.5 percent and bilingualism increased by 34 percent. In this province, however, the hypothesized move towards bilingualism for the population of French mother tongue may have had an English counterpart; the population of English mother tongue increased by 9.4 percent, but the population speaking English only grew by 6 percent.

The population able to speak neither official language declined by over 10 percent in all provinces except Manitoba and British Columbia (note that data for Prince Edward Island and the Yukon were based on very small frequencies in 1971). In general, the data suggest relatively high rates of acquisition of English (or French, or both) for persons of other mother tongue; for most provinces, the number of persons with other mother tongues increased, while the number speaking neither French nor English decreased. The exceptions were Alberta and British Columbia; in these two provinces, the pattern may well be due to the immigration of persons unable to speak either official language.

I calculated values of the mutual information for official language categories by province, for 1971 and 1981. These data are shown in Tables 12 and 13. We find the by now familiar association between province of residence and language characteristics: increasing association between distance from Quebec and English monolingualism (with maxima in the East for Newfoundland, in the West for Saskatchewan), increasing negative association between distance from Quebec and French monolingualism (largest negative values found for Newfoundland and British Columbia) and a comparable association for official bilingualism (largest negative values found for Newfondland and British Columbia in 1971, Saskatchewan in 1981). The inability to speak either official language seems to be associated with residence in Ontario, Manitoba, British Columbia and the Northwest Territories.

A detailed comparison between Tables 12 and 13 shows that the mutual information of province and official language did not change all that much from 1971 to 1981. Most notable were the changes in mutual information for those speaking French only; an increase in an already positive value for Quebec, combined with decreases in negative values for the other provinces. Here again, we find indications of the increased concentration of French monolingualism in Quebec. Note, furthermore, the relatively large changes in mutual information for bilinguals in Prince Edward Island, Manitoba, Saskatchewan and the Northwest Territories (becoming increasingly negative) and New Brunswick (becoming larger positive), as well as the value for Alberta which "goes against the grain" by becoming less negative.

TABLE 12
Mutual Information for the Cross-Classification of Province of Residence by Official Language, Canada 1971

	English Only	French Only	Both	Neither
Newfoundland	.379	-5.216	-2.016	-2.515
Prince Edward Island	.307	-3.385	-.500	-4.009
Nova Scotia	.322	-3.522	-.693	-2.428
New Brunswick	-.070	-.122	.467	-2.751
Quebec	-1.855	1.219	.719	-.341
Ontario	.263	-2.703	-.369	.400
Manitoba	.285	-3.567	-.496	.341
Saskatchewan	.333	-4.511	-.996	-.210
Alberta	.334	-4.484	-.994	-.292
British Columbia	.338	-5.400	-1.063	-.191
Yukon	.328	-6.494	-.715	-2.051
Northwest Territories	.088	-4.137	-.792	2.621

TABLE 13
Mutual Information for the Cross-Classification of Province of Residence by Official Language, Canada 1981

	English	French	Both	Neither
Newfoundland	.377	-6.502	-1.904	-2.764
Prince Edward Island	.315	-4.609	-.639	-3.736
Nova Scotia	.321	-4.304	-.722	-2.536
New Brunswick	-.101	-.245	.549	-2.909
Quebec	-2.303	1.289	.752	-.410
Ontario	.259	-3.150	-.344	.361
Manitoba	.300	-4.162	-.661	.224
Saskatchewan	.346	-5.414	-1.209	-.477
Alberta	.322	-4.594	-.865	-.178
British Columbia	.327	-5.470	-.990	.173
Yukon	.316	-5.946	-.662	-1.825
Northwest Territories	.177	-4.834	-.927	2.444

Median values across provinces remain virtually constant for English only (from .315 to .316) and for bilinguals (from -.704 to -.692), increase (negatively) for French only (from -3.852 to -4.602) and for those able to speak neither official language (from -.317 to -.444).

Following the line of analysis used on the mother tongue data, I also constructed the matrix of joint proportions we would expect if the internal changes were entirely due to the changes in marginal distributions. Table 14 gives the comparison between the observed proportions in 1981 with the expected values. As with the analysis for the mother tongue data, the marginal adjustment procedure explains most of the intercensal change in the spatial pattern by official language. The total information inaccuracy (that is, the "error" we would make if we postulated that the joint distribution for 1971 described that for 1981 correctly) was .00835. The marginally adjusted values reduce the total information inaccuracy to .00282, a reduction of about 66 percent. Recall that we may interpret this to mean that, of the total intercensal change for 1971-81, about two-thirds may be explained by changes in the marginal distributions by province and by categories of official languages spoken. Particularly bad estimates are produced for several now familiar groups: English monolinguals in Quebec (where the decline was much larger than expected), French monolinguals in Nova Scotia, New Brunswick, Ontario, Manitoba and Saskatchewan (where the procedure estimated little or no change, while the observed declines were fairly substantial), bilinguals in Manitoba and Saskatchewan (estimated increases, but observed decreases) and those speaking neither official language in British Columbia (observed increase, but an expected decrease).

TABLE 14
Observed and Expected Proportions, Joint Distribution of Province by Official Language, Canada, 1981

	English Only		French Only		Both		Neither	
	Observed	Expected	Observed	Expected	Observed	Expected	Observed	Expected
Newfoundland	.0228	.0228	.0000	.0000	.0005	.0005	.0000	.0000
Prince Edward Island	.0046	.0045	.0000	.0000	.0004	.0005	.0000	.0000
Nova Scotia	.0322	.0317	.0001	.0002	.0026	.0029	.0000	.0000
New Brunswick	.0173	.0168	.0037	.0046	.0076	.0072	.0000	.0000
Quebec	.0177	.0250	.1589	.1557	.0858	.0825	.0021	.0021
Ontario	.3073	.3025	.0025	.0045	.0384	.0403	.0062	.0065
Manitoba	.0380	.0368	.0001	.0002	.0033	.0042	.0006	.0007
Saskatchewan	.0376	.0367	.0000	.00001	.0018	.0024	.0003	.0004
Alberta	.0849	.0850	.0002	.0002	.0059	.0057	.0009	.0008
British Columbia	.1046	.1048	.0001	.0001	.0064	.0065	.0016	.0012
Yukon	.0009	.0009	.0000	.0000	.0001	.0001	.0000	.0000
Northwest Territories	.0015	.0014	.0000	.0000	.0001	.0002	.0003	.0003

4. Summary

So far we have analyzed the distribution of the population by mother tongue and by official languages spoken, by province, for the period 1971-81. We have seen that general patterns (the "ecology of language") changed very little at that level of spatial detail. Overall trends showed slight relative losses for the population of French mother tongue, for those speaking French only and for those speaking neither English or French. Relative gains were most pronounced for the population speaking both English and French. These broadly constant distributions masked, to some degree, relatively intensive processes of change affecting several provincial linguistic minorities rather strongly. We noted the decline of the English mother tongue population in Quebec, in particular where this was associated with the inability to speak French. Moreover, we noted hints of continuing erosion for the French minorities outside Quebec, most clearly for Manitoba, Saskatchewan, Newfoundland and Prince Edward Island, but also tangible for Ontario and New Brunswick. It appears that the French-language minorities in Alberta and British Columbia were given temporary reprieves in the process of decline, by rather high levels of net immigration.

The analyses conducted so far have yielded a few answers, but many more additional questions. While the more sophisticated techniques suggested that much of the intercensal change may be "explained" by changes in marginal distributions, such explanations are only statistical in nature. In other words, to state that Manitoba and Saskatchewan had declining

percentages of the total Canadian population leads to further questions about population change; to what degree was this phenomenon attributable to differential rates of natural increase, to what degree was it associated with internal or external migration? In a similar vein, the partial explanation based on high rates of increase for bilinguals begs a whole sequence of further questions regarding the underlying processes. Was the increase in bilingualism due to higher rates of natural increase, or to the effects of international migration or to the acquisition of the second official language by persons who in 1971 were able to speak one (only) or neither of the official languages?

Moreover, the isolated deviations from these overall rather stable conditions invite further analysis. On the one hand, we would like to move some of the spatial analyses to lower levels of aggregation, say counties and census divisions. On the other hand, we will need to check out to what degree the various hunches about minority language maintenance and shift are borne out by the data.

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